2008 SCEC REPORT

SCEC COORDINATION WITH EARTHQUAKE ENGINEERING RESEARCH AND PRACTICE

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INTRODUCTION

The development of new knowledge about earthquakes and their effects is an important role of SCEC, but not its only role. Because earthquakes have major impacts on society, SCEC must also transfer knowledge about earthquakes and their effects for use in earthquake risk mitigation. This includes the transfer of knowledge to organizations involved in earthquake engineering research and practice. In the following, I described the activities that I undertook in 2008.

1. 2008 SCEC EARTHQUAKE ENGINEERING & SCIENCE WORKSHOP, SEPTEMBER 7.

This half day workshop, immediately preceding the SCEC Annual Meeting, offered engineers and scientists an opportunity to focus plans for future collaborative activities related to earthquake engineering and science. The question central to the workshop was: *How should SCEC collaborate with the earthquake engineering community?* Interested earthquake engineers and scientists were invited to provide recommendations for future research activities through discussions of 1) current collaborative activities supported by SCEC, and 2) relevant activities and needs of the earthquake engineering community. Representatives from the earthquake engineering community (e.g. ASCE 7, BSSC, CUREE, EERI, LATBSDC, MAE, MCEER, NEES, PEER) and SCEC scientists provided brief summaries to stimulate discussions. The workshop proceedings and recommendations will be used to plan future SCEC research directions.

2. FOSTERING GROWTH IN PARTICIPATION IN SCEC BY ENGINEERS

I am actively fostering the participation of highly capable young engineers in SCEC. These participants include prominent young engineers such as Jack Baker of Stanford University and Keith Porter of the University of Colorado. At the 2007 Annual Meeting, it was agreed that we establish a goal of doubling the 2007 level of participation, which was about 3%, to make this group about 5% of the SCEC Community. I continued to identify additional candidates through my participation in meetings with the earthquake engineering research community described below. Approximately 20 engineers, or 4%, attended the 2008 Annual Meeting.

3. COORDINATION OF ONGOING SCEC PROJECTS

I coordinated SCEC activities that involved interaction of SCEC scientists with earthquake engineers involved in advanced research and practice. These included SCEC projects that funded in 2008, and other interactions with earthquake engineers that developed during the course of the year.

In the course of SCEC 2, I helped to develop a number of special projects, most with funding separate from SCEC core funds, which apply SCEC science and knowledge to earthquake engineering research and practice. The following paragraphs describe the activities of four special projects.

4. PROPOSAL TO NSF CMMI/EAR

The Shakeout Exercise highlighted research needs in Southern California at the interface between earthquake science and earthquake engineering. A key issue is the vulnerability (including collapse potential) of tall buildings in Los Angeles during large earthquakes on the Southern San Andreas Fault, and the development of methods for identifying these buildings. This topic is the subject of a joint SCEC/PEER proposal that I prepared and submitted to NSF for joint funding by EAR and CMMI. The title of the proposal is Collaborative Research (Scec/Peer): Benchmarking Methods for Assessing Seismic Safety of Tall Buildings. The proposal builds on the work done by SCEC in the ShakeOut exercise and the work being done in the Tall Buildings Initiative. The requested budget is approximately $600,000, shared between SCEC and PEER over three years.

5. BROADBAND PLATFORM AND NGA-H

SCEC participated in the first phase, NGA-E (empirical) of this project, whose focus was the updating of empirical ground motion models. The second phase of the project, NGA-H (hybrid), will involve the use of broadband strong motion simulation to generate ground motion time histories for use, in conjunction with recorded ground motions, in the development of ground motion attenuation relations for hard rock. The NGA-H phase of the project, which has not yet begun, will involve much more participation by SCEC than did NGA-E.

A major precondition for the initiation of the NGA-H program and SCEC's involvement in it is the development of the Broadband Strong Motion Simulation Platform. Testing of the Broadband Platform by a representative of the NGA Program was completed in November 2007. The next step is the completion of further validation of the three simulation methods against recorded strong ground motions, especially at high frequencies, and demonstration that the three methods are in reasonably close agreement when simulating scenario earthquake ground motions. I coordinated the development and submission of proposals to SCEC to perform these validation exercises, and obtained cost sharing of $100,000 from PG&E for that work.

6. PEER TALL BUILDINGS INITIATIVE

SCEC has almost completed Task 4 of this project, which involves the simulation of ground motion time histories of large earthquakes in Los Angeles and San Francisco for use by practicing engineers in the design of tall buildings. My work was to ensure that the simulated broadband ground motion time histories for use in the design of tall buildings in Los Angeles and San Francisco are generated in ways that meet the engineering needs of the project; are accepted for use by the earthquake engineering community as represented by Project Advisory Committee and its technical subcommittees; and are modified in appropriate ways when subjected to procedures for

scaling and spectral matching for engineering application. The work involved coordination of SCEC and USGS broadband ground motion simulation activities, and the transfer of suitable subsets of the simulated ground motion time histories to the TBI Project.

7: NEESR GRAND CHALLENGE: SEISMIC RISK MANAGEMENT FOR PORT SYSTEMS

SCEC provided ground motion time histories for use in this NEESR Grand Challenge project, related to seismic risk management for port systems. This Grand Challenge project utilizes the resources of the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES), a program initiated by the National Science Foundation to advance the field of earthquake engineering. NEES is a shared national network of experimental sites and tools, a centralized data repository, and an archive of earthquake engineering simulation software, all linked together by ultra-high-speed Internet2 connections. Together, these resources provide the means for collaboration and discovery in the form of more advanced research based on experimentation and computational simulations of earthquakes.

Seaports serve as critical gateways for this trade, but many U.S. ports are located in areas with significant seismic hazard. The damage caused by earthquakes and associated business interruption losses can have devastating consequences for the port and broader, adverse effects on local, regional, national, and international stakeholders. This NEESR Grand Challenge project is integrating geotechnical and structural earthquake engineering research with expertise in port system operations and risk and decision analysis to develop a framework for seismic risk analysis of containerized port systems. Individual tasks are focused on:

- predicting the seismic response and resulting damage states of key port components such as container wharves and cranes via large-scale experimentation and numerical simulation,
- estimating the effects of damage to these components on cargo-handling capacity and the resulting impact on port revenues, and
- mitigating possible losses via both geotechnical and structural engineering design and retrofit options.

The results of these tasks will enable port stakeholders to perform a comprehensive seismic risk analysis that examines losses due to property damage and business interruption. Such an analysis can help stakeholders gain a better understanding of their facilities' vulnerability to earthquakes, potential economic consequences, and possible benefits of investing in more stringent seismic design and retrofit.

8. NEESR-SG SEISMIC PERFORMANCE IN DENSE URBAN ENVIRONMENTS

I served on the Professional Practice Committee for the NEESR-SG: "Seismic Performance Assessment in Dense Urban Environments" project (also known as "Shaking of a City Block"). This project is funded by a Small Grant from the Network for Earthquake Engineering Simulation – Research. The objective of the project is to enhance the profession’s understanding of soil-structure interaction effects of buildings in a dense urban environment by performing centrifuge experiments, where the input

motion, ground conditions, ground response, and structural response can be carefully tracked, followed by back-analyses of these model tests. The intent is to take advantage of available knowledge and recent research findings, and a goal is to produce research findings and products that can be readily used by practicing engineers.

9. CEA (CALIFORNIA EARTHQUAKE AUTHORITY)

SCEC was invited by the CEA to provide input into its long term research program, and I participated in meetings related to the development of that long term research program for CEA. The CEA long term research program has not yet been released. I followed the development of CEA's Long Term Research Program and sought opportunities for SCEC's participation in it. A particular focus was follow up on Project 3 of the now completed SCEC-CEA Program, which was a study of end-to-end simulation of the response of woodframe buildings to earthquake ground motion. This was a pilot study that was undertaken to explore the potential value of this approach to reducing uncertainty in earthquake loss estimation. Several issues, summarized in a report to CEA, remain to be explored before the approach is ready for implementation by CEA. A brief summary of future directions that could be taken to address these issues and advance the end-to-end simulation approach to a form that is ready for practical implementation by CEA were provided to CEA on May 8, 2008.

10. PARTICIPATION IN MEETINGS WITH ENGINEERING RESEARCH AND PRACTICE ORGANIZATIONS

I participated in meetings with numerous engineering organizations that are involved in research and practice. My participation in these meetings provides a vehicle for communication of SCEC research results and products to these engineering organizations, and informs me of new developments in earthquake engineering research and practice, providing a basis for the planning of future collaborative projects between SCEC and these organizations.

11. PARTICIPATION IN SCEC MEETINGS

I participated in all of the SCEC meetings that are relevant to the Implementation Interface. These meetings include the Planning Committee Meeting, The Leadership Meeting, the Annual Meeting, and workshops in fields that are closely related to the Implementation Interface, including the Extreme Ground Motion Project.